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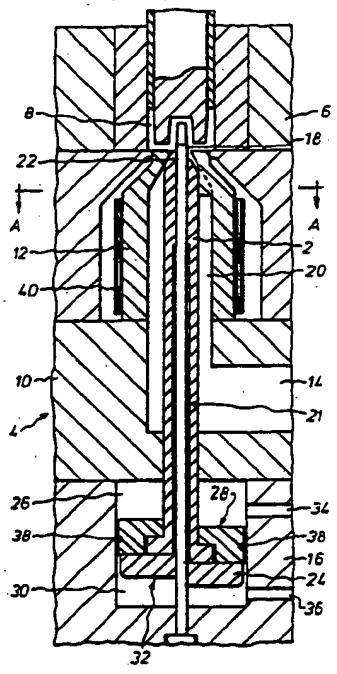
(54) Title: ARRANGEMENT IN INJECTION MOULDS

(57) Abstract

An arrangement is provided in an injection mould with a hot-runner system, comprising a stationary mould part (4) and a movable mould part (6) including mould cavities (8), runner blocks (10), tab sleeves (12), at least one needle valve (2) movable between two end positions, and an operating means (16, 24). The novel features of the inventive arrangement reside in that the needle valve (2) has at least one bore extended in the axial direction for providing a tubular valve, that a core (22) is at least partly supported in said bore for movement relative to the needle valve (2), and that a portion of the core (22) extends into the mould cavity (8) to form a dead hole or a through hole in the finished moulded article.



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ARRANGEMENT IN INJECTION MOULDS

The present invention relates to an arrangement for use in conventional injection moulds, comprising a hot-runner system, and more particularly a needle valve having a bore or bores extending through part or the whole of its length, and a stationary or a movable core.

Injection moulding of especially small plastic articles with through holes or dead holes involves problems as to the design of the mould cavity, e.g. regarding the location of the cavity gate to ensure optimal mould filling and to produce practically sprue-free articles. These requirements are especially important in the making of precision-moulded articles, such as medico-technical equipment, since excessive tolerances, low resistance or dimensional deviations of the moulded articles may lead to malfunction, with a consequent risk of bodily injuries.

Demands for high quality and reduced manufacturing costs have been incentives to the development of hot-runner systems in which valve nozzles with solid needles have replaced to an increasing extent conventional tunnel-type gates.

Several different arrangements are known for making articles with through holes. US-A-4,521,179 thus describes an arrangement which has an extended needle valve whose extension passes into the mould cavity, and in which the flow of material through the nozzle can be shut off by displacing said extension in the axial direction.

A similar arrangement is described in US-A-4,530,654. Also in this arrangement, the needle valve has a narrow, needle-like extension, but the flow of material through the nozzle is here shut off in a known manner by actuation of the needle valve.

In this context, US-A-4,368,028 may also be mentioned. This patent specification describes a core or pin provided with a conical tip portion and supported in a bore in the lower mould part. For guiding purposes, a conical

recess is provided in the torpedo, i.e. the stationary needle valve, which does not permit manufacturing sprue-free articles. The recess has a shape corresponding to the conical tip portion of the core, and in operation, i.e. during injection moulding of an article, these parts are engaging each other.

Finally, reference is made to US-A-4,657,496 having for its object to provide an arrangement for injection moulding articles, not formed with any holes or channels and consisting of a plurality of layers of different materials.

This object is achieved by the provision of a hot-runner system for injection moulding, which comprises a first hot-runner passage which communicates with an outlet opening arranged in a hot-runner block, and which is itself arranged in said hot-runner block, an outer needle valve supported in the first hot-runner passage, a second hot-runner passage which communicates with an outlet opening arranged in the outer needle valve and which is itself arranged in said outer needle valve, and an inner needle valve movably supported in said second hot-runner passage, said inner needle valve being shifted back and forth, such that the front end thereof executes an opening/closing operation at each outlet opening in the hot-runner block and in the outer needle valve.

One drawback inherent in the known technique of making articles formed with bores or channels is that the extension of the needle valve is displaced in the axial direction when the needle valve is moved for opening or closing the passage of the flow of material. This movement may lead to impaired manufacturing precision or damage to the article and, if it comes to the worst, to improper function of the finished product.

Another drawback of the known technique are the limitations in respect of the shaping of the holes in the articles. According to known techniques, it is impossible, for instance, to form conical holes or holes with reverse

taper, but only cylindrical holes, i.e. holes of uniform diameter in the longitudinal direction thereof, can be produced.

The above-mentioned or similar systems thus operate less satisfactorily in the making of small precision-moulded details formed with e.g. through holes or dead holes.

One object of the invention therefore is to produce sprue-free articles formed with through holes or dead holes, with a gate surrounding the hole for optimal mould filling.

Another object of the invention is to provide an arrangement permitting the use of large gates without any sprue remaining on the articles.

According to the invention, these objects are achieved by the provision of an arrangement in an injection mould with a hot-runner system, comprising a stationary mould part and a movable mould part including mould cavities, runner blocks, tab sleeves, at least one needle valve movable between an opening position and a closing position, and operating means actuating said needle valve, said arrangement being characterised in that the needle valve has at least one, axially extended bore, that a core is at least partly supported in said bore such that the needle valve and the core are axially displaceable relative to each other, and that at least in one mould-filling position a portion of the core is extended into the mould cavity to form a dead hole or a through hole in the finished article.

Other embodiments and modifications of the invention will appear from the accompanying subclaims.

Embodiments of the arrangement according to the invention will be described in more detail hereinbelow with reference to the accompanying drawings, in which:

Fig. 1 is a sectional view of part of an injection mould comprising an inventive needle valve according to a first embodiment, in which the valve, to the left of the

line of symmetry, is in a closing position and, to the right of the line symmetry, in an open position;

Fig. 2 is a sectional view taken along the line A-A in Fig. 1;

Fig. 3 is a sectional view of part of an injection mould comprising an inventive needle valve according to a second embodiment, in which the valve, to the left of the line of symmetry, is in a closing position and, to the right of the line of symmetry, in an open position.

Fig. 4 is a sectional view similar to Fig. 2 and taken along the line B-B in Fig. 3, and

Fig. 5 is a sectional view similar to Figs 2 and 4 and showing another needle valve provided with bores.

Figs 1 and 2 show a first embodiment of an inventive needle valve 2 which is included in an injection mould, of which only part is shown here for greater clarity.

As is known in the art, the mould has a stationary mould part 4 and a movable mould part 6 which are provided with a mould cavity 8. A runner block 10 further comprises a tab sleeve 12, a runner passage 14 and a housing 16. The runner block 10 has an outlet or gate 18 which via a hot runner 20 arranged in the tab sleeve 12 and the runner block 10 is connectible to the runner passage 14.

The hot runner 20 supports the needle valve 2 which in this embodiment is formed with an elongate central through bore 21 and itself supports a core 22, see especially Fig. 2. The gate 18 is concentrically disposed relative to the core 22, and also to the needle valve 2, and has a larger diameter than the core 22 to allow passage of moulding material into the cavity 8 when the mould, consisting of the stationary mould part 4 and the movable mould part 6, is closed.

In the embodiment here described, the position of the core 22 is fixed and the core is attached to the housing 16. In this context, it should however be pointed out that the core can be fixed e.g. to a piston and cylinder assem-

bly (not shown) for executing an axial movement independently of the needle vavle.

For performing a movement back and forth, the end of the needle valve 2 remote from the gate 18 is fixed at a piston 24 movable in the housing 16, i.e. at the stationary mould part 4. Thus, there is defined a first chamber 26 defined by the inside of the cylinder housing 16 and a first piston face 28, and a second chamber 30 defined by the inside of the cylinder housing 16 and a second piston face 32.

Numeral 34 designates a first fluid channel for feeding pressurised fluid into the first chamber 26, and numeral 36 designates a second fluid channel for feeding pressurised fluid into the second chamber 30. Numeral 38 generally designates sealing means, such as O-rings.

The tab sleeve 12, like the needle valve 2, has a conical cross-section adjacent the gate 18 and is provided with a heater element 40.

As in other known injection moulds, the runner passage 14 branches into several hot runners corresponding to the hot runner shown in Fig. 1, such that several articles can be injection moulded at the same time.

The core of the needle valve operating each hot runner may have different cross-sections and/or a different extent into the cavity when the mould is closed. Thus, the core, or at least the portion of the core extended into the cavity, may have circular, hexagonal or other cross-sectional shape.

Figs 3 and 4 show a second embodiment of the arrangement according to the invention. Since this embodiment is similar in many respects to the embodiment described above with reference to Figs 1 and 2, like parts have like reference numerals and will not be described in more detail here. Reference is thus also made to the description of Figs 1 and 2.

Concentrically with the gate 18 is disposed a needle valve 42 which extends into the hot runner 20. The end of the needle valve 42 remote from the gate 18 is fixed at the piston 24 of a piston and cylinder assembly. Also in the embodiment here described, the needle valve 42 has a central bore 44, see Fig. 4, which is however not a through bore, but has a depth adjusted to the length of a core 48 disposed concentrically with the bore 44 and also with the gate 18 of the cavity 46 in the movable mould part 6.

In the embodiment shown in Fig. 3, the core 48 is fixed in the side of the cavity 46 remote from the gate 18, i.e. in the movable mould part 6. The part of the core 48 extended into the mould cavity has such a cross-section that the hole formed in the moulded article will be given the desired shape, while the end portion of the core has a shape fitting in the bore of the needle valve 42.

An alternative embodiment of the inventive needle valve is shown in Fig. 5 in a sectional view similar to Figs 2 and 4. Here, a needle valve 52 is formed with two bores 54, 56 which may extend through part or the whole of the needle valve 52, as described above with respect to the first and the second embodiment.

Both Fig. 1 and Fig. 3 illustrate two different working positions of the needle valve 2 and 42, respectively. To the left of the line of symmetry of the arrangement, the needle valve 2 and 42, respectively, is in a position closing the outlet or gate 18. To the right of the line of symmetry, the needle valve 2 and 42, respectively, is in a retracted position in relation to the first position, the hot melt passing from the runner passage 14 and the hot runner 20 through the gate 18 and filling the cavity 8 and 46, respectively. Since the tip portion of the needle valve and the end of the tab sleeve located at the gate have substantially the same conicity, small axial displacements of the needle valve are sufficient for opening and closing the passage of the melt.

As appears from the drawings, the embodiment shown in Figs 1 and 2 is suited for forming both through channels or holes and depressions or dead holes which extend through part of the moulded article and are optionally threaded, provided the free end of the core extending into the mould cavity has a corresponding external thread, while the embodiment shown in Figs 3 and 4 is especially well suited for forming through channels or holes. In both cases, the holes or channels can be given the desired cross-section, e.g. hexagonol, by a corresponding shape of at least the part of the core which is extended into the mould cavity. With the embodiment shown in Fig. 5, it is possible to produce several dead holes and/or channels in the same moulded article. It should here also be pointed out that, for making articles with through channels or holes, the core 22 shown in Figs 1 and 2 can pass axially into a hole (not shown) provided in the movable mould part 6.

After mould closure, the needle valve 2 or 42 is shifted by supplying pressurised fluid, such as compressed air, through the channel 34 into the first chamber 26, to the second retracted position in which the gate 18 is open.

In this position, the melt will flow through the runner passage 14, the hot runner 20 and the gate 18 into the cavity 8 or 46. The cavity is filled, and the part of the core extended into the cavity forms the desired depression or hole in the finished article.

After the cavity 8 or 46 has been filled, the needle valve 2 or 42 is shifted by supplying pressurised fluid, preferably compressed air, through the channel 36 into the second chamber 30, to the first position in which the gate 18, here annular, is closed and in which the melt thus is prevented from passing into the cavity 8 or 46, which after a short cooling time is opened to permit removal of the moulded article. The mould is thereafter again closed, and a new cycle is started.

In the foregoing, embodiments of the inventive arrangement have been described which permit manufacturing especially small articles, formed with channels or holes, with high accuracy in an injection moulding process, in which optimal gate positioning is ensured in respect of flow paths and moulding precision, dimensional stability, resistance etc., by the provision of a core concentrically in the needle valve.

CLAIMS

1. An arrangement in an injection mould with a hot-runner system, comprising a stationary mould part (4) and a movable mould part (6) including mould cavities (8; 46), runner blocks (10), tab sleeves (12), at least one needle valve (2; 42) movable between an opening position and a closing position, and operating means (16, 24) actuating said needle valve, c h a r a c t e r i s e d in that the needle valve (2; 42) has at least one, axially extended bore (21; 44; 54, 56), that a core (22; 48) is at least partly supported in said bore such that the needle valve (2; 42; 52) and the core (22; 48) are axially displaceable relative to each other, and that at least in one mould-filling position a portion of the core (22; 48) is extended into the mould cavity (8; 46) to form a dead hole or a through hole in the finished article.

2. Arrangement as claimed in claim 1, c h a r a c t e r i s e d in that the core (22; 48) defines an annular gate (18) of optional centre cross-section.

3. Arrangement as claimed in claim 1, c h a r a c t e r i s e d in that the core (48) is fixed at the movable mould part (6) and extends through the mould cavity (46) and a gate (18), and that a free end of the core (48) extends coaxially into the central bore (44) of the needle valve (42) when the mould is closed, said needle valve (42) being connected to said operating means (16, 24).

4. Arrangement as claimed in claim 3, c h a r a c t e r i s e d in that the free end of the core (48) is frustoconical, thus improving the guiding performance and reducing the wear when the core (48) and the needle valve (42) engage each other.

5. Arrangement as claimed in claim 1, c h a r a c t e r i s e d in that the needle valve (2) has a coaxial central through bore and that the core (22) has a portion which when the mould is closed extends into the mould

cavity (8) and passes into an elongate part extending through the central bore of the needle valve (2) and which also extends beyond the end of the needle valve (2) remote from a gate (18), said needle valve end being connected to the operating means (16, 24), and said core (22) being detachably fixed at the stationary mould part (4) at a distance from said needle valve end.

6. Arrangement as claimed in claim 1, c h a r a c t e r i s e d in that the needle valve (2) has a coaxial central through bore, and that the core (22) has a portion which when the mould is closed extends into the mould cavity (8) and passes into an elongate part extending through the central bore of the needle valve (2) and which also extends beyond the end of the needle valve (2) remote from a gate (18), said needle valve end being connected to the operating means (16, 24), and said core (22) being connected to a second operating means at a distance from said needle valve end and displaceable in the longitudinal direction by actuation of said second operating means, such that the core (22) is operable when the mould is closed or open or when being opened, and such that the length of the core portion extending into the mould cavity (8) is adjustable and/or said core portion is rotatable.

7. Arrangement as claimed in any one of claims 1-6, c h a r a c t e r i s e d in that the portion of the core (22; 48) extending into the mould cavity (8; 46) when the mould is closed has a circular cross-section of one or more different diameters.

8. Arrangement as claimed in any one of claims 1-6, c h a r a c t e r i s e d in that the core (22; 48) in its longitudinal direction has different, optional cross-sections.

9. Arrangement as claimed in any one of claims 1-8, c h a r a c t e r i s e d in that the portion of the core (22; 48) extending into the mould cavity (8; 46) when the mould is closed has an external thread.

FIG. 1

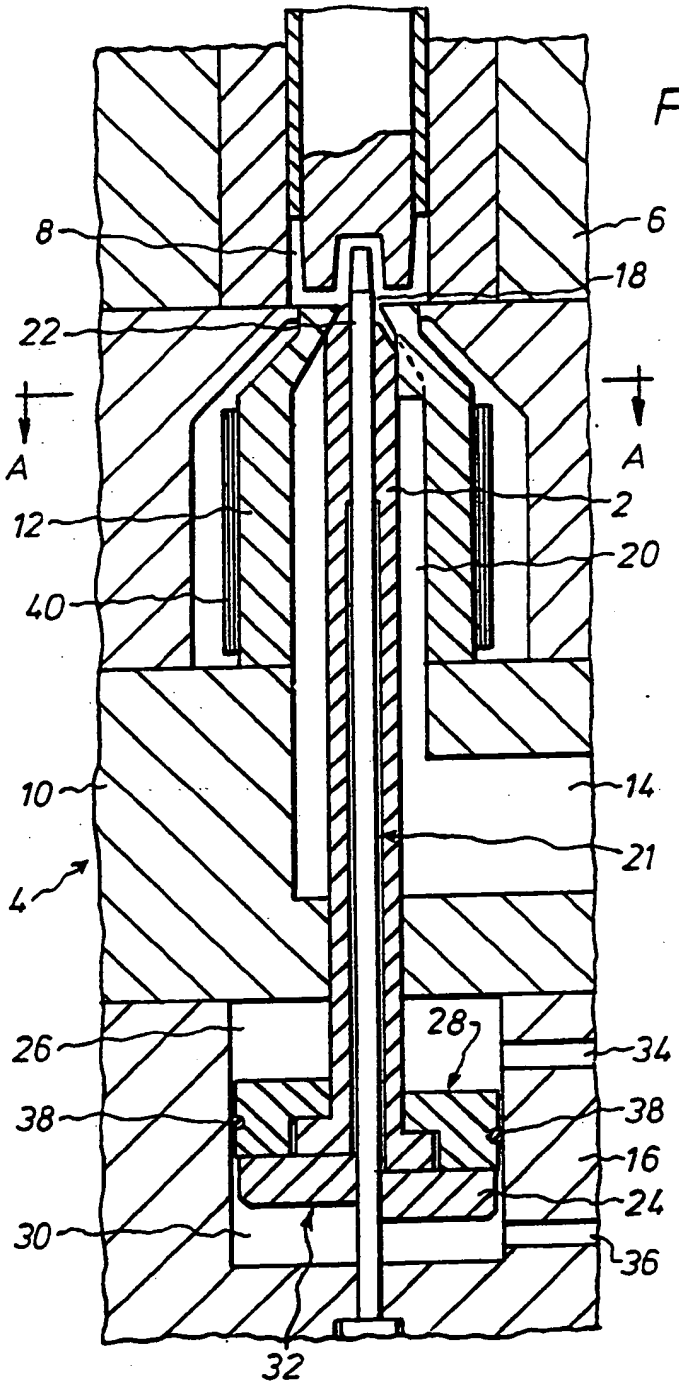
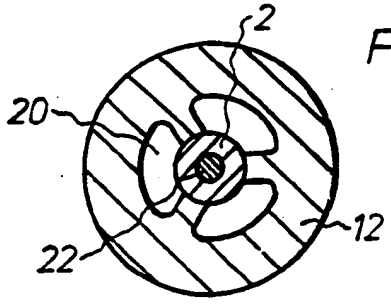


FIG. 2



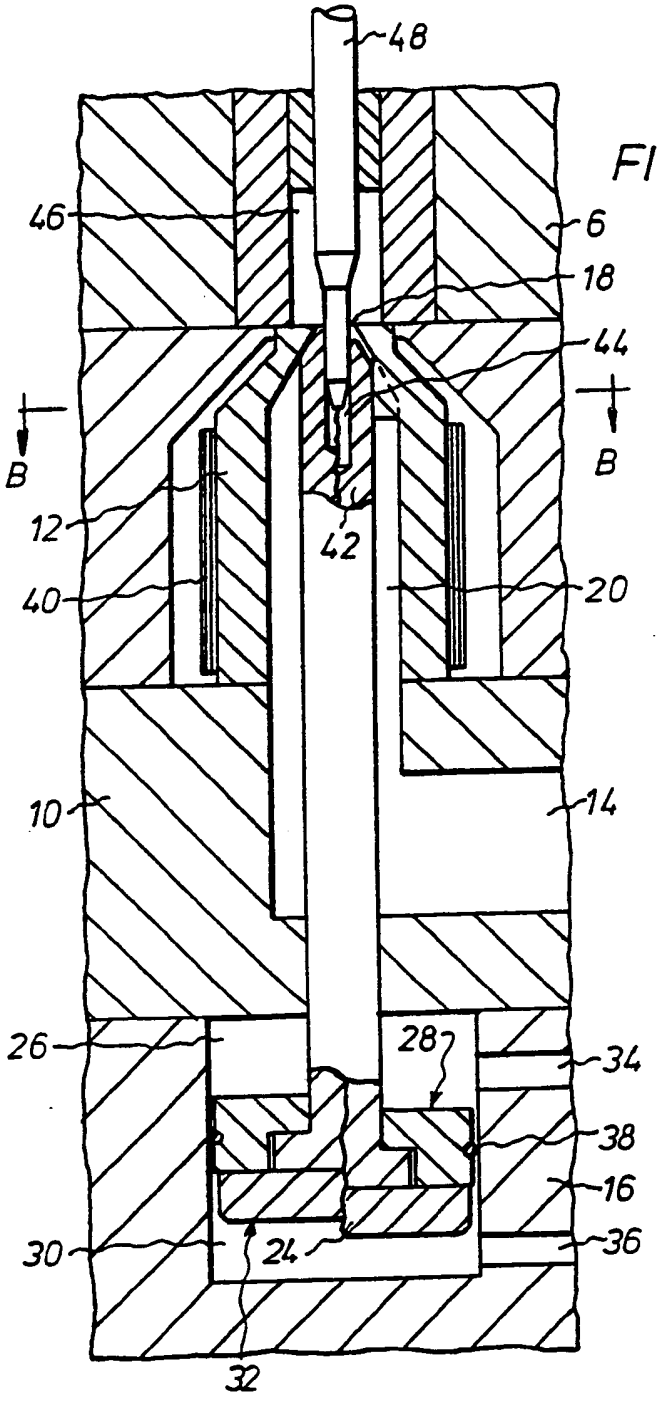


FIG.3

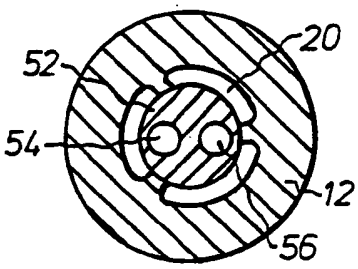


FIG.5

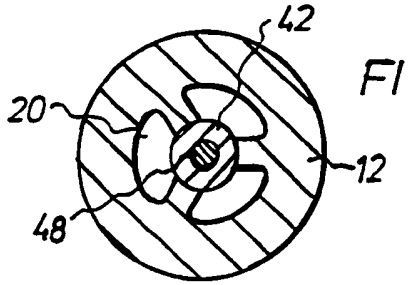


FIG.4

INTERNATIONAL SEARCH REPORT

International Application No PCT/SE 91/00392

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC5: B 29 C 45/20

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
IPC5	B 29 C

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched[8]

SE,DK,FI,NO classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category *	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
A	DE, A1, 2816014 (GELLERT, JOBST ULRICH) 9 November 1978, see figure 1 --	1
A	EP, A1, 0106980 (GELLERT, JOBST ULRICH) 2 May 1984, see figure 1 --	1
A	EP, A, 0163083 (MOLD-MASTERS LIMITED) 4 December 1985, see figure 1 --	1
A	US, A, 4368028 (GRISH ET AL) 11 January 1983, see figure 1 --	1
A	US, A, 4521179 (GELLERT) 4 June 1985, see figure 1 --	1
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"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
20th August 1991	1991 -09- 10
International Searching Authority	**Signature of Authorized Officer**
SWEDISH PATENT OFFICE	Jan Nilsson

Form PCT/ISA/210 (second sheet) (January 1985)

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.PCT/SE 91/00392

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the Swedish Patent Office EDP file on 91-06-27
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		JP-A-	53134860	78-11-24
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		EP-A-B-	0117510	84-09-05
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